CLAIMS

What is claimed is:

1. A compound comprising a peptide chain approximately 10 to 40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids of formula (I)

(I) $CX_1X_2X_3X_4X_5X_6X_7X_8C$ (SEQ ID NO: 1)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X_1 is A, N, S, F, D, G, L, T, E, V, P, Q, H, M or K; X_2 is M, G, R, H, D, I, V, A, S, E, N, F, Y, P, C, W or T; X_3 is E, V, W, F, M, A, N, S, L, T, Y, G or P; X_4 is V, I, G, Q, W, M, T, Y, L, P, D, C, E or A; X_5 is M, E, W, L, P, N, I, T, V, F, Y, Q, S, R, W, G, H or D; X_6 is H, A, W, Y, V, F, Q, M, N, E, S, D, P or G; X_7 is M, F, Y, V, N, L, H, D, S, W, G, Q, C or T; and X_8 is C, Y, R, I, K, W, L, E, M, H, A, T, F, D, P, G or Q.

2. The compound of claim 1, wherein X_1 is D or P.

3. The compound of claim 1, wherein X_2 is D or P.

4. The compound of claim 1, wherein X_3 is E or W.

5. The compound of claim 1, wherein X_4 is V, I or Y.

6. The compound of claim 1, wherein X_5 is M or L.

7. The compound of claim 1, wherein X_6 is W, Y or F.

8. The compound of claim 1, wherein X_7 is M, Y or D.

9. The compound of claim 1, wherein X_8 is C or M.

10. The compound of claim 1, wherein the sequence of amino acids is selected from the group consisting of:

CAGEVMHMCC (SEQ ID NO: 8);
CNREIEAMCC (SEQ ID NO: 9);
CADEVMHFCC (SEQ ID NO: 10);
CNREIMWMCC (SEQ ID NO: 11);
CSHEVWWYCC (SEQ ID NO: 12);
CSREVLYYCC (SEQ ID NO: 13);
CFIEGPWVCC (SEQ ID NO: 14);
CFVEGNWYCC (SEQ ID NO: 15);
CAAEVMVNCC (SEQ ID NO: 16);
CSDEVIFYCC (SEQ ID NO: 17);
CDREIMWFCC (SEQ ID NO: 18);
CAHEVMWMCC (SEQ ID NO: 19);
CGSEVTFMCC (SEQ ID NO: 20);
CLEEIMWLCC (SEQ ID NO: 21);
CAREVLAMCC (SEQ ID NO: 22);
CSVEVMQMCC (SEQ ID NO: 23);
CTNVQLMHYC (SEQ ID NO: 24);
CDVWQLFDRC (SEQ ID NO: 25);
CSFVQLNSIC (SEQ ID NO: 26);
CDYWQWFDKC (SEQ ID NO: 27);
CESFWVELWC (SEQ ID NO: 28);
CVPWMFYDLC (SEQ ID NO: 29);
CDPWMFYDLC (SEQ ID NO: 30);
CDPWVLFDEC (SEQ ID NO: 31);
CDHWTYFDMC (SEQ ID NO: 32);
CVVWTLYDKC (SEQ ID NO: 33);

CPDWYQSYMC (SEQ ID NO: 34);
CPDWYSYYMC (SEQ ID NO: 35);
CPEWYTDVMC (SEQ ID NO: 36);
CPDWYLDYMC (SEQ ID NO: 37);
CPEWYLDYMC (SEQ ID NO: 38);
CPDWYLPYMC (SEQ ID NO: 39);
CPEWYLPYMC (SEQ ID NO: 40);
CQDWWVELWC (SEQ ID NO: 41);
CPDWYLPWMC (SEQ ID NO: 42);
CACMLRVVHC (SEQ ID NO: 43);
CQRAGYMLAC (SEQ ID NO: 44);
CHANPVWGEC (SEQ ID NO: 45);
CFWSDWGQTC (SEQ ID NO: 46);
CPHWTSYYMC (SEQ ID NO: 47);
CETLCGACFC (SEQ ID NO: 48);
CATTINDTLC (SEQ ID NO: 49);
CLNYPHPVFC (SEQ ID NO: 50);
CMDGEMAVDC (SEQ ID NO: 51);
CNMGWMSWPC (SEQ ID NO: 52);
CETYADWLGC (SEQ ID NO: 53);
CDPWMFFDMC (SEQ ID NO: 54);
CDPWIWYDLC (SEQ ID NO: 55);
CDPWIMYDRC (SEQ ID NO: 56);
CDPWVFFDIC (SEQ ID NO: 57);
CDPWTYYDLC (SEQ ID NO: 58);
CDPWIFYDRC (SEQ ID NO: 59);
CDPWLFYDLC (SEQ ID NO: 60);
CDPWVWYDLC (SEQ ID NO: 61);

CDPWIFFDRC (SEQ ID NO: 62);
CDPWMFFDQC (SEQ ID NO: 63);
CDPWLWYDRC (SEQ ID NO: 64);
CDVWVWYDQC (SEQ ID NO: 65);
CDPWIYYDLC (SEQ ID NO: 66);
CVPWTLFDLC (SEQ ID NO: 67);
CPAWYLEYMC (SEQ ID NO: 68);
CPDWYLEYMC (SEQ ID NO: 69);
CKYWQWFDKC (SEQ ID NO: 70); and
CDHWMWYDKC (SEQ ID NO: 71).

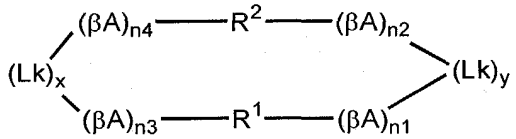
11. The compound of claim 10, wherein the sequence of amino acids is selected from the group consisting of:

GCNREIEAMCCG (SEQ ID NO: 72);
GCPEWYTDVMCG (SEQ ID NO: 73);
NWYCMDGEMAVDCEAT (SEQ ID NO: 74);
WQSCNMGWMSWPCYFV (SEQ ID NO: 75);
HELCETYADWLGCVEW (SEQ ID NO: 76);
PCDPWMFFDMCERW (SEQ ID NO: 77);
LRGCDPWIWYDLCPAV (SEQ ID NO: 78);
GYLCDPWIXYDRCLGF (SEQ ID NO: 79);
RFACDPWVFFDICGYW (SEQ ID NO: 80);
GYWCDPWTYYDLCLTA (SEQ ID NO: 81);
MWTCDPWIFYDRCFLN (SEQ ID NO: 82);
GSSCDPWLFYDLCLLD (SEQ ID NO: 83);
GGGCDPWVWYDLCWCD (SEQ ID NO: 84);
YTSCDPWIFFDRCMSV (SEQ ID NO: 85);
DPYCDPWMFFDQCAYL (SEQ ID NO: 86);

REFCDPWLWYDRCL (SEQ ID NO: 87);
NTGCDVWVWYDQCFAM (SEQ ID NO: 88);
LVFCDPWIYYDLCMDT (SEQ ID NO: 89);
GCSFVQLNSICG (SEQ ID NO: 90);
GCPAWYLEYMCG (SEQ ID NO: 91);
GCPDWYLEYMCG (SEQ ID NO: 92);
GCKYWQWFDKCG (SEQ ID NO: 93); and
GCDHWMWYDKCG (SEQ ID NO: 94).

12. The compound of claim 1, comprising a dimer having the structure of formula (VIII)

(VIII)



wherein R^1 and R^2 are independently selected from the sequences of amino acids of formula (I); βA is a β-alanine residue; n1, n2, n3, n4, x and y are independently zero or one with the proviso that the sum of x and y is either one or two; and Lk is a terminal linking moiety selected from the group consisting of a disulfide bond, a carbonyl moiety, a C_{1-12} linking moiety optionally terminated with one or two -NH- linkages and optionally substituted at one or more available carbon atoms with a lower alkyl substituent, a lysine residue or a lysine amide.

13. The compound of claim 1, containing a disulfide bond.

14. The compound of claim 1, wherein the N-terminus of the peptide is coupled to a polyethylene glycol molecule.

15. The compound of claim 1, wherein the N-terminus of the peptide is acetylated.

16. The compound of claim 1, wherein the C-terminus of the peptide is amidated.

17. A pharmaceutical composition comprising a therapeutically effective amount of the compound of claim 1 in combination with a pharmaceutically acceptable carrier.

18. A method for treating a patient who would benefit from administration of a G-CSF modulator, comprising administering to the patient a therapeutically effective amount of a compound comprising a peptide chain approximately 10-40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids having the structural formula (I)

(I) $CX_1X_2X_3X_4X_5X_6X_7X_8C$ (SEQ ID NO: 1)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X_1 is A, N, S, F, D, G, L, T, E, V, P, Q, H, M or K; X_2 is M, G, R, H, D, I, V, A, S, E, N, F, Y, P, C, W or T; X_3 is E, V, W, F, M, A, N, S, L, T, Y, G or P; X_4 is V, I, G, Q, W, M, T, Y, L, P, D, C, E or A; X_5 is M, E, W, L, P, N, I, T, V, F, Y, Q, S, R, W, G, H or D; X_6 is H, A, W, Y, V, F, Q, M, N, E, S, D, P or G; X_7 is M, F, Y, V, N, L, H, D, S, W, G, Q, C or T; and X_8 is C, Y, R, I, K, W, L, E, M, H, A, T, F, D, P, G or Q.

19. The method of claim 18, wherein the G-CSF modulator is an agonist for the G-CSFR.

20. The method of claim 19, wherein the patient suffers from a depressed neutrophil count.

21. The method of claim 20, wherein the depressed neutrophil count is caused by a condition selected from the group consisting of chemotherapy-induced neutropenia, AIDS-induced neutropenia and community-acquired pneumonia-induced neutropenia.

22. The method of claim 18, wherein the G-CSF modulator is an antagonist for the G-CSFR.

23. A compound comprising a peptide chain approximately 9 to 40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids of formula (II)

(II) $X^I_1X^I_2X^I_3$SGWVWX^I_4 (SEQ ID NO: 2)

wherein each amino acid is indicated by the standard one-letter abbreviation, and wherein X^I_1 is S, Q, R, L or Y; X^I_2 is N, S, T, A or D; X^I_3 is E, D or N; and X^I_4 is L V, T, P or H.

24. The compound of claim 23, wherein X^I_1 is S or Q.

25. The compound of claim 23, wherein X^I_2 is S.

26. The compound of claim 23, wherein X^I_3 is N.

27. The compound of claim 23, wherein X^I_4 is V.

28. The compound of claim 23, wherein the sequence of amino acids is selected from the group consisting of:

SNESGWVWL (SEQ ID NO: 95);

QSNSGWVWV (SEQ ID NO: 96);

RTESGWVWT (SEQ ID NO: 97);

RANSGWVWV (SEQ ID NO: 98);

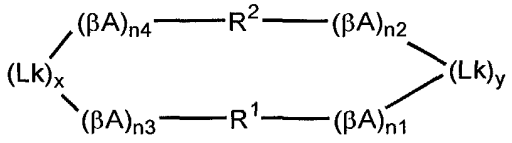
YDNSGWVWH (SEQ ID NO: 99); and

LSDSGWVWVP (SEQ ID NO: 100).

29. The compound of claim 28, wherein the sequence of amino acids is selected from the group consisting of:

EQSNSGWVWVGGGGC (SEQ ID NO: 101);
CEQSNSGWVWV (SEQ ID NO: 102);
EQSNSGWVWVGGGGCKKK (SEQ ID NO: 103);
EQSNSGWVWVGKKKC (SEQ ID NO: 104);
EQSNSGWVWVGKKK (SEQ ID NO: 105);
KKKEQSNSGWVWV (SEQ ID NO: 106);
EQSNSGWVWVGKKKSKKK (SEQ ID NO: 107);
EQSNSGWVWVGGCKKK (SEQ ID NO: 108);
EQSNSGWVWVGGGGGGCKKK (SEQ ID NO: 109);
SNESGWVWLP (SEQ ID NO: 110);
EQSNSGWVWV (SEQ ID NO: 111);
SRTESGWVWT (SEQ ID NO: 112);
QRANSGWVWV (SEQ ID NO: 113);
DYDNSGWVWH (SEQ ID NO: 114).
EQSNSGWVWVGKKKK (SEQ ID NO: 115);
EQSNSGWVWVGGGGSKKK (SEQ ID NO: 116);
EQSNSGWVWVGGGGS (SEQ ID NO: 117);
EQSNSGWVWVGGGGSEQSNSGWVWVGGGGS (SEQ ID NO: 118);
RYQSFELSDSGWVWVPVARH (SEQ ID NO: 119); and
EQSNSGWVWVGGGGCKKKC (SEQ ID NO: 492)

30. The compound of claim 23, comprising a dimer having the structure of formula (VIII)

(VIII) 

wherein R^1 and R^2 are independently selected from the sequences of amino acids of formula (II); βA is a β-alanine residue; n1, n2, n3, n4, x and y are independently zero or one with the proviso that the sum of x and y is either one or two; and Lk is a terminal linking moiety selected from the group consisting of a disulfide bond, a carbonyl moiety, a C_{1-12} linking moiety optionally terminated with one or two -NH- linkages and optionally substituted at one or more available carbon atoms with a lower alkyl substituent, a lysine residue or a lysine amide.

31. The compound of claim 30, wherein the dimer is:
NH_2-EQSNSGWVWVGGGGC-$CONH_2$ (SEQ ID NO: 101)
|
NH_2-EQSNSGWVWVGGGGC-$CONH_2$ (SEQ ID NO: 101);

32. The compound of claim 23, containing a disulfide bond.

33. The compound of claim 23, wherein the N-terminus of the peptide is coupled to a polyethylene glycol molecule.

34. The compound of claim 23, wherein the N-terminus of the peptide is acetylated.

35. The compound of claim 23, wherein the C-terminus of the peptide is amidated.

36. A pharmaceutical composition comprising a therapeutically effective amount of the compound of claim 23 in combination with a pharmaceutically acceptable carrier.

37. A method for treating a patient who would benefit from administration of a G-CSF modulator, comprising administering to the patient a therapeutically effective amount of a compound comprising a peptide chain approximately 9 to 40 amino acids that binds to G-CSF and contains a sequence of amino acids having the structural formula (II)

(II) $X^I_1X^I_2X^I_3SGWVWX^I_4$ (SEQ ID NO: 2)

wherein each amino acid is indicated by the standard one-letter abbreviation, and wherein X^I_1 is S, Q, R, L or Y; X^I_2 is N, S, T, A or D; X^I_3 is E, D or N; and X^I_4 is L V, T, P or H.

38. The method of claim 37, wherein the G-CSF modulator is an agonist for the G-CSFR.

39. The method of claim 38, wherein the patient suffers from a depressed neutrophil count.

40. The method of claim 39, wherein the depressed neutrophil count is caused by a condition selected from the group consisting of chemotherapy-induced neutropenia, AIDS-induced neutropenia and community-acquired pneumonia-induced neutropenia.

41. The method of claim 37, wherein the G-CSF modulator is an antagonist for the G-CSFR.

42. A compound comprising a peptide chain approximately 6 to 40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids of formula (III)

(III) $ERX^{II}_1X^{II}_2X^{II}_3C$ (SEQ ID NO: 3)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X^{II}_1 is D, L, S, G, E, A, K or Y; X^{II}_2 is W, Y, F, L or V; and X^{II}_3 is F, G, M or L.

43. The compound of claim 42, wherein X^{II}_1 is D or L.

44. The compound of claim 42, wherein X^{II}_2 is W.

45. The compound of claim 42, wherein X^{II}_3 is F.

46. The compound of claim 42, wherein the sequence of amino acids is selected from the group consisting of:

ERDWFC (SEQ ID NO: 120);
ERDWGC (SEQ ID NO: 121);
ERLWFC (SEQ ID NO: 122);
ERSYFC (SEQ ID NO: 123);
ERGWFC (SEQ ID NO: 124);
EREWFC (SEQ ID NO: 125);
ERAWFC (SEQ ID NO: 126);
ERLYFC (SEQ ID NO: 127);
ERYFMC (SEQ ID NO: 128);
ERLFLC (SEQ ID NO: 129);
ERALMC (SEQ ID NO: 130);
ERDVMC (SEQ ID NO: 131); and
ERKWFC (SEQ ID NO: 132).

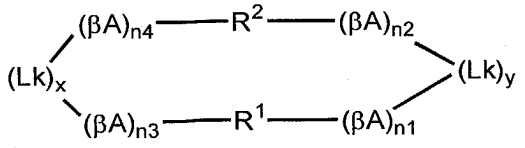
47. The compound of claim 46, wherein the sequence of amino acids is selected from the group consisting of:

ETWGERDWFC (SEQ ID NO: 133);

ETWGERDWGC (SEQ ID NO: 134);
STAERLWFCG (SEQ ID NO: 135);
YETAERSYFC (SEQ ID NO: 136);
ADNAERGWFC (SEQ ID NO: 137);
QSNSEREWFC (SEQ ID NO: 138);
STSERAWFCG (SEQ ID NO: 139);
ASWSERGWFC (SEQ ID NO: 140);
ELSSEREWFC (SEQ ID NO: 141);
DMQGERGWFC (SEQ ID NO: 142);
SSSERAWFCG (SEQ ID NO: 143);
GNMRERLYFC (SEQ ID NO: 144);
QPNRERYFMC (SEQ ID NO: 145);
SVTRERLFLC (SEQ ID NO: 146);
IPLSERALMCSSWNC (SEQ ID NO: 147);
WARSERDVMCLSYVC (SEQ ID NO: 148);
QSNSEREWFCG (SEQ ID NO: 149);
QSNSEREWFCGGGGS (SEQ ID NO: 150);
NLEEALAQERLWFCRSGNC (SEQ ID NO: 151); and
NLESYEMEERKWFCKMFSC (SEQ ID NO: 152).

48. The compound of claim 42, comprising a dimer having the structure of formula (VIII)

(VIII)



wherein R^1 and R^2 are independently selected from the sequences of amino acids of formula (III); βA is a β-alanine residue; n1, n2, n3, n4, x and y are independently zero or

one with the proviso that the sum of x and y is either one or two; and Lk is a terminal linking moiety selected from the group consisting of a disulfide bond, a carbonyl moiety, a C_{1-12} linking moiety optionally terminated with one or two -NH- linkages and optionally substituted at one or more available carbon atoms with a lower alkyl substituent, a lysine residue or a lysine amide.

49. The compound of claim 42, containing a disulfide bond.

50. The compound of claim 49, selected from the group consisting of:

NH_2-STAERLWFCG-$CONH_2$ (SEQ ID NO: 135)

NH_2-STAERLWFCG-$CONH_2$ (SEQ ID NO: 135);

NH_2-QSNSEREWFC-$CONH_2$ (SEQ ID NO: 138)

NH_2-QSNSEREWFC-$CONH_2$ (SEQ ID NO: 138); and

NH_2-QSNSEREWFCG-$CONH_2$ (SEQ ID NO: 149)

NH_2-QSNSEREWFCG-$CONH_2$ (SEQ ID NO: 149).

51. The compound of claim 42, wherein the N-terminus of the peptide is coupled to a polyethylene glycol molecule.

52. The compound of claim 42, wherein the N-terminus of the peptide is acetylated.

53. The compound of claim 42, wherein the C-terminus of the peptide is amidated.

54. A pharmaceutical composition comprising a therapeutically effective amount of the compound of claim 42 in combination with a pharmaceutically acceptable carrier.

55. A method for treating a patient who would benefit from administration of a G-CSF modulator, comprising administering to the patient a therapeutically effective amount of a compound comprising a peptide chain approximately 6 to 40 amino acids that binds to G-CSFR and contains a sequence of amino acids having the structural formula (III)

(III) $ERX^{II}_1X^{II}_2X^{II}_3C$ (SEQ ID NO: 3)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X^{II}_1 is D, L, S, G, E, A, K or Y; X^{II}_2 is W, Y, F, L or V; and X^{II}_3 is F, G, M or L.

56. The method of claim 55, wherein the G-CSF modulator is an agonist for the G-CSFR.

57. The method of claim 56, wherein the patient suffers from a depressed neutrophil count.

58. The method of claim 57, wherein the depressed neutrophil count is caused by a condition selected from the group consisting of chemotherapy-induced neutropenia, AIDS-induced neutropenia and community-acquired pneumonia-induced neutropenia.

59. The method of claim 55, wherein the G-CSF modulator is an antagonist for the G-CSFR.

60. A compound comprising a peptide chain approximately 9 to 40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids of formula (IV)

(IV) $X^{III}_1MVYX^{III}_2X^{III}_3PX^{III}_4W$ (SEQ ID NO: 4)

wherein each amino acid in indicated by standard one-letter abbreviation, and wherein X^{III}_1 is D or E; X^{III}_2 is A or T; X^{III}_3 is Y or V; and X^{III}_4 is P or Y.

61. The compound of claim 60, wherein the sequence of amino acids is selected from the group consisting of:

DMVYAYPPW (SEQ ID NO: 153); and

EMVYTVPYW (SEQ ID NO: 154).

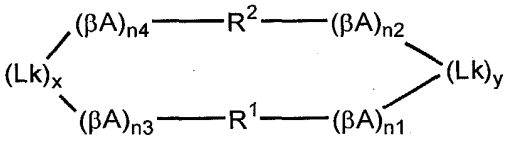
62. The compound of claim 61, wherein the sequence of amino acids is selected from the group consisting of:

DMVYAYPPWS (SEQ ID NO: 155); and

DEMVYTVPYW (SEQ ID NO: 156).

63. The compound of claim 60, comprising a dimer having the structure of formula (VIII)

(VIII)



wherein R^1 and R^2 are independently selected from the sequences of amino acids of formula (IV); βA is a β-alanine residue; n1, n2, n3, n4, x and y are independently zero or one with the proviso that the sum of x and y is either one or two; and Lk is a terminal linking moiety selected from the group consisting of a disulfide bond, a carbonyl moiety, a C_{1-12} linking moiety optionally terminated with one or two -NH- linkages and optionally substituted at one or more available carbon atoms with a lower alkyl substituent, a lysine residue or a lysine amide.

64. The compound of claim 60, containing a disulfide bond.

65. The compound of claim 60, wherein the N-terminus of the peptide is coupled to a polyethylene glycol molecule.

66. The compound of claim 60, wherein the N-terminus of the peptide is acetylated.

67. The compound of claim 60, wherein the C-terminus of the peptide is amidated.

68. A pharmaceutical composition comprising a therapeutically effective amount of the compound of claim 60 in combination with a pharmaceutically acceptable carrier.

69. A method for treating a patient who would benefit from administration of a G-CSF modulator, comprising administering to the patient a therapeutically effective amount of a compound comprising a peptide chain approximately 9 to 40 amino acids that binds to G-CSFR and contains a sequence of amino acids having the structural formula (IV)

(IV) $X^{III}_1MVYX^{III}_2X^{III}_3PX^{III}_4W$ (SEQ ID NO: 4)

wherein each amino acid in indicated by standard one-letter abbreviation, and wherein X^{III}_1 is D or E; X^{III}_2 is A or T; X^{III}_3 is Y or V; and X^{III}_4 is P or Y.

70. The method of claim 69, wherein the G-CSF modulator is an agonist for the G-CSFR.

71. The method of claim 70, wherein the patient suffers from a depressed neutrophil count.

72. The method of claim 71, wherein the depressed neutrophil count is caused by a condition selected from the group consisting of chemotherapy-induced neutropenia, AIDS-induced neutropenia and community-acquired pneumonia-induced neutropenia.

73. The method of claim 69, wherein the G-CSF modulator is an antagonist for the G-CSFR.

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74. A compound comprising a peptide chain approximately 12 to 40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids of formula (V)

(V) $CX^{IV}_1X^{IV}_2X^{IV}_3X^{IV}_4X^{IV}_5X^{IV}_6X^{IV}_7X^{IV}_8X^{IV}_9X^{IV}_{10}C$ (SEQ ID NO: 5)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X^{IV}_1 is E, G, P, N, R, T, W, S, L, H, A, Q or Y; X^{IV}_2 is S, T, E, A, D, G, W, P, L, N, V, Y, R or M; X^{IV}_3 is R, Y, V, Q, E, T, L, P, S, K, M, A or W; X^{IV}_4 is L, M, G, F, W, R, S, V, P, A, D, C or T; X^{IV}_5 is V, T, A, R, S, L, W, C, I, E, P, H, F, D or Q; X^{IV}_6 is E, Y, G, T, Q, M, S, N, A or P; X^{IV}_7 is C, V, D, G, L, W, E, V, I, S, M or A; X^{IV}_8 is S, Y, A, W, P, V, L, Q, G, K, F, I, E or D; X^{IV}_9 is R, W, M, D, H, V, G, A, Q, L, S, E or Y; X^{IV}_{10} is M, L, I, S, V, P, W, F, T, Y, R, or Q.

75. The compound of claim 74, wherein X^{IV}_1 is E.

76. The compound of claim 74, wherein X^{IV}_2 is S or A.

77. The compound of claim 74, wherein X^{IV}_3 is R.

78. The compound of claim 74, wherein X^{IV}_4 is L.

79. The compound of claim 74, wherein X^{IV}_5 is V or S.

80. The compound of claim 74, wherein X^{IV}_6 is E.

81. The compound of claim 74, wherein X^{IV}_7 is C.

82. The compound of claim 74, wherein X^{IV}_8 is S.

83. The compound of claim 74, wherein X^{IV}_9 is R.

84. The compound of claim 74, wherein X^{IV}_{10} is L.

85. The compound of claim 74, wherein the sequence of amino acids is selected from the group consisting of:

CESRLVECSRMC (SEQ ID NO: 157);
CETYMTYVYWLC (SEQ ID NO: 158);
CGERLAECARLC (SEQ ID NO: 159);
CESRLRECSMLC (SEQ ID NO: 160);
CEARLSECSRIC (SEQ ID NO: 161);
CPARLLECSRMC (SEQ ID NO: 162);
CESVGVGDWWSC (SEQ ID NO: 163);
CEDRLVEGPWVC (SEQ ID NO: 164);
CNDQFRTCVDVC (SEQ ID NO: 165);
CRGEWWELYHPC (SEQ ID NO: 166);
CEDTRTGWAWSC (SEQ ID NO: 167);
CTWLSSGELVWC (SEQ ID NO: 168);
CWPPVCEVSGIC (SEQ ID NO: 169);
CSLSPIQLQHLC (SEQ ID NO: 170);
CLARLEECSRFC (SEQ ID NO: 171);
CHNSSPMVGVTC (SEQ ID NO: 172);

CHVSPVQIKALC (SEQ ID NO: 173);
CAAPATSWFQYC (SEQ ID NO: 174);
CASKLHECSLRC (SEQ ID NO: 175);
CEPMDSNGIVQC (SEQ ID NO: 176);
CQYASAADEQRC (SEQ ID NO: 177);
CEYWDEPSLSWC (SEQ ID NO: 178);
CERECFQMLERC (SEQ ID NO: 179);
CGMSTDELDEIC (SEQ ID NO: 180);
CYVSPSTGLYSC (SEQ ID NO: 181);
CEARLVECSRLC (SEQ ID NO: 182);
CESRLSECSRMC (SEQ ID NO: 183);
CELKLQECARRC (SEQ ID NO: 184);
CELKLQEAARRC (SEQ ID NO: 185); and
CLERLEECSRFC (SEQ ID NO: 186).

86. The compound of claim 85, wherein the sequence of amino acid is selected from the group consisting of:

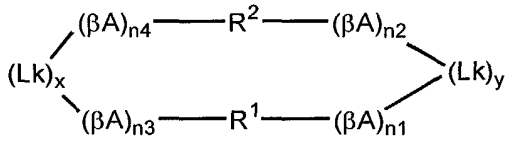
GGCESRLVECSRMC (SEQ ID NO: 187);
GGCETYMTYVYWLC (SEQ ID NO: 188);
EWLCESVGVGDWWSC (SEQ ID NO: 189);
YHPCEDRLVEGPWVCCRS (SEQ ID NO: 190);
WLLCNDQFRTCVDVCDNV (SEQ ID NO: 191);
IAECRGEWWELYHPCLAA (SEQ ID NO: 192);
TWYCEDTRTGWAWSCLEL (SEQ ID NO: 193);
QLDCTWLSSGELVWCSDW (SEQ ID NO: 194);
QFDCTWLSSGELVWCSDW (SEQ ID NO: 195);
CWPPVCEVSGICS (SEQ ID NO: 196);
CGCSLSPIQLQHLC (SEQ ID NO: 197);

CGCHVSPVQIKALC (SEQ ID NO: 198);
GCHVSPVQIKALC (SEQ ID NO: 199);
GTSCAAPATSWFQYCVLP (SEQ ID NO: 200);
RMDCASKLHECSLRCAYA (SEQ ID NO: 201);
GVVCEPMDSNGIVQCSMR (SEQ ID NO: 202);
IDVCQYASAADEQRCLRI (SEQ ID NO: 203);
NVLCEYWDEPSLSWCLSS (SEQ ID NO: 204);
CQCERECFQMLERC (SEQ ID NO: 205);
FCSCGMSTDELDEICAIW (SEQ ID NO: 206);
EEVCYVSPSTGLYSCYDQ (SEQ ID NO: 207);
LLDICELKLQECARRCN (SEQ ID NO: 208);
GGGLLDICELKLQECARRCN (SEQ ID NO: 209);
GRTGGGLLDICELKLQECARRCN (SEQ ID NO: 210);
LGIEGRTGGGLLDICELKLQECARRCN (SEQ ID NO: 211);
LLDICELKLQEAARRCN (SEQ ID NO: 212); and
KLLDICELKLQEAARRCN (SEQ ID NO: 213).

87. The compound of claim 86, wherein the sequence of amino acids is selected from the group consisting of:

LLDICELKLQECARRCN (SEQ ID NO: 208);
GGGLLDICELKLQECARRCN (SEQ ID NO: 209);
GRTGGGLLDICELKLQECARRCN (SEQ ID NO: 210);
LGIEGRTGGGLLDICELKLQECARRCN (SEQ ID NO: 211);
LLDICELKLQEAARRCN (SEQ ID NO: 212); and
KLLDICELKLQEAARRCN (SEQ ID NO: 213).

88. The compound of claim 74, comprising a dimer having the structure of formula (VIII)

(VIII) 

wherein R^1 and R^2 are independently selected from the sequences of amino acids of formula (V); βA is a β-alanine residue; n1, n2, n3, n4, x and y are independently zero or one with the proviso that the sum of x and y is either one or two; and Lk is a terminal linking moiety selected from the group consisting of a disulfide bond, a carbonyl moiety, a C_{1-12} linking moiety optionally terminated with one or two -NH- linkages and optionally substituted at one or more available carbon atoms with a lower alkyl substituent, a lysine residue or a lysine amide.

89. The compound of claim 74, containing a disulfide bond.

90. The compound of claim 89, having the structure:
NH_3^+-LLDICELKLQECARRCN-COO$^-$ (SEQ ID NO: 208)
NH_3^+-LLDICELKLQECARRCN-COO$^-$ (SEQ ID NO: 208).

91. The compound of claim 74, wherein the N-terminus of the peptide is coupled to a polyethylene glycol molecule.

92. The compound of claim 74, wherein the N-terminus of the peptide is acetylated.

93. The compound of claim 74, wherein the C-terminus of the peptide is amidated.

94. A pharmaceutical composition comprising a therapeutically effective amount of the compound of claim 74 in combination with a pharmaceutically acceptable carrier.

95. A method for treating a patient who would benefit from administration of a G-CSF modulator, comprising administering to the patient a therapeutically effective amount of a compound comprising a peptide chain approximately 12 to 40 amino acids that binds to G-CSFR and contains a sequence of amino acids having the structural formula (V)

(V) $CX^{IV}_1X^{IV}_2X^{IV}_3X^{IV}_4X^{IV}_5X^{IV}_6X^{IV}_7X^{IV}_8X^{IV}_9X^{IV}_{10}C$ (SEQ ID NO: 5)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X^{IV}_1 is E, G, P, N, R, T, W, S, L, H, A, Q or Y; X^{IV}_2 is S, T, E, A, D, G, W, P, L, N, V, Y, R or M; X^{IV}_3 is R, Y, V, Q, E, T, L, P, S, K, M, A or W; X^{IV}_4 is L, M, G, F, W, R, S, V, P, A, D, C or T; X^{IV}_5 is V, T, A, R, S, L, W, C, I, E, P, H, F, D or Q; X^{IV}_6 is E, Y, G, T, Q, M, S, N, A or P; X^{IV}_7 is C, V, D, G, L, W, E, V, I, S, M or A; X^{IV}_8 is S, Y, A, W, P, V, L, Q, G, K, F, I, E or D; X^{IV}_9 is R, W, M, D, H, V, G, A, Q, L, S, E or Y; X^{IV}_{10} is M, L, I, S, V, P, W, F, T, Y, R, or Q.

96. The method of claim 95, wherein the G-CSF modulator is an agonist for the G-CSFR.

97. The method of claim 96, wherein the patient suffers from a depressed neutrophil count.

98. The method of claim 97, wherein the depressed neutrophil count is caused by a condition selected from the group consisting of chemotherapy-induced neutropenia, AIDS-induced neutropenia and community-acquired pneumonia-induced neutropenia.

99. The method of claim 95, wherein the G-CSF modulator is an antagonist for the G-CSFR.

100. The method of claim 99, wherein the G-CSF modulator is

NH_3^+-LLDICELKLQECARRCN-COO$^-$ (SEQ ID NO: 208)

NH_3^+-LLDICELKLQECARRCN-COO$^-$ (SEQ ID NO: 208).

101. A compound comprising a peptide chain approximately 9 to 40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids of formula (VI)

(VI) $X^V_1X^V_2X^V_3X^V_4X^V_5X^V_6CX^V_7X^V_8$ (SEQ ID NO: 6)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X^V_1 is E, C, Q, V, or Y; X^V_2 is E, A, L, M, S, W, or Q; X^V_3 is K, R or T; X^V_4 is L, A, or V; X^V_5 is R, A, M, H, E, V, L, G, D, Q, or S; X^V_6 is E or V; X^V_7 is A or G; X^V_8 is R, H, G or L.

102. The compound of claim 101, wherein X^V_1 is E.

103. The compound of claim 101, wherein X^V_2 is A or L.

104. The compound of claim 101, wherein X^V_3 is K or R.

105. The compound of claim 101, wherein X^V_4 is L.

106. The compound of claim 101, wherein X^V_6 is E.

107. The compound of claim 101, wherein X^V_7 is A.

108. The compound of claim 101, wherein X^V_8 is R.

109. The compound of claim 101, wherein the sequence of amino acids is selected from the group consisting of:

EEKLRECAR (SEQ ID NO: 214);
EARLAECAR (SEQ ID NO: 215);
CMKLMECAR (SEQ ID NO: 216);
ELRLRECAH (SEQ ID NO: 217);
EAKLHECAR (SEQ ID NO: 218);
ELKLAECAR (SEQ ID NO: 219);
EARLEECAR (SEQ ID NO: 220);
EAKLRECAR (SEQ ID NO: 221);
ELRLAECAR (SEQ ID NO: 222);
ESRLAECAR (SEQ ID NO: 223);
EAKLVECAR (SEQ ID NO: 224);
ESRLRECAR (SEQ ID NO: 225);
EAKLAECAR (SEQ ID NO: 226);
QWRLEECAR (SEQ ID NO: 227);
QLRLEECAR (SEQ ID NO: 228);
ELRLEECAR (SEQ ID NO: 229);
EAKLLECAR (SEQ ID NO: 230);
EARAGVCAG (SEQ ID NO: 231);
EAKAGVCAG (SEQ ID NO: 232);
VARLEECAR (SEQ ID NO: 233);
ELKLDECAR (SEQ ID NO: 234);
EWRLQECAR (SEQ ID NO: 235);
EAKLSECAR (SEQ ID NO: 236);
EARLSECAR (SEQ ID NO: 237);
ELKLLECAR (SEQ ID NO: 238);
ELRLQECGR (SEQ ID NO: 239);

EQKLAECAR (SEQ ID NO: 240);
ELRLQECAR (SEQ ID NO: 241);
ELKLEECAR (SEQ ID NO: 242);
ESRLEECAR (SEQ ID NO: 243);
EATVQECAR (SEQ ID NO: 244);
ELKLQECAR (SEQ ID NO: 245);
YSRLEECGR (SEQ ID NO: 246);
ELRLRECAL (SEQ ID NO: 247);
EARLLECAR (SEQ ID NO: 248);
ESRLLECAR (SEQ ID NO: 249);
VLKLEECAR (SEQ ID NO: 250);
ESKLAECAR (SEQ ID NO: 251);
ESKLRECAR (SEQ ID NO: 252);
EYKLGECAR (SEQ ID NO: 253);
ESRLQECAR (SEQ ID NO: 254);
QARLAECAR (SEQ ID NO: 255);
ELKKQECAR (SEQ ID NO: 256);
ESRLSECAR (SEQ ID NO: 257);
EARLEECGR (SEQ ID NO: 258);
ESRLAECGR (SEQ ID NO: 259);
EWRLEECAR (SEQ ID NO: 260);
EARLSECGR (SEQ ID NO: 261);
AARLAECAR (SEQ ID NO: 262);
EWKLAECAR (SEQ ID NO: 263);
ESKLEECAR (SEQ ID NO: 264);
DVKLAECAR (SEQ ID NO: 265);
ELQLEECAR (SEQ ID NO: 266); and
EYKLASCAR (SEQ ID NO: 267).

110. The compound of claim 109, wherein the sequence of amino acids is selected from the group consisting of:

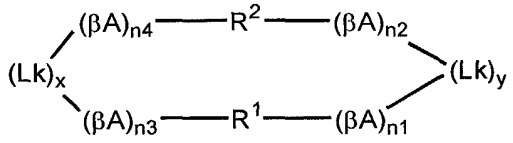
RLSICEEKLRECARGC (SEQ ID NO: 268);
PLTTCEARLAECARQL (SEQ ID NO: 269);
LALCMKLMECARRY (SEQ ID NO: 270);
ELVMCELRLRECAHRA (SEQ ID NO: 271);
PLARCEAKLHECARQL (SEQ ID NO: 272);
LLSVCELKLAECARSK (SEQ ID NO: 273);
RLEWCEARLEECARRC (SEQ ID NO: 274);
RLRVVEAKLRECARGR (SEQ ID NO: 275);
CVAHLELRLAECARQI (SEQ ID NO: 276);
HLARCESRLAECARQL (SEQ ID NO: 277);
RLALLEAKLVECARRL (SEQ ID NO: 278);
DLFSLESRLRECARRV (SEQ ID NO: 279);
AVPVLEAKLAECARRF (SEQ ID NO: 280);
YLQQLQWRLEECARGM (SEQ ID NO: 281);
YLELCQLRLEECARQFN (SEQ ID NO: 282);
ELHICELRLEECARGR (SEQ ID NO: 283);
RVARCELRLAECARKS (SEQ ID NO: 284);
YLEVLESRLAECARWK (SEQ ID NO: 285);
EAKLLECARAR (SEQ ID NO: 286);
ELSLCEARAGVCAGSVTK (SEQ ID NO: 287);
ELSLCEAKAGVCAGSVTK (SEQ ID NO: 288);
ALWQCVARLEECARSR (SEQ ID NO: 289);
CLKSCELKLDECARRM (SEQ ID NO: 290);
ALQTCEWRLQECARSR (SEQ ID NO: 291);
YISQCEAKLAECARLY (SEQ ID NO: 292);
ELSSCEAKLSECARRW (SEQ ID NO: 293);

ELSSCEARLSECARRW (SEQ ID NO: 294);
QLLQCELKLLECARQG (SEQ ID NO: 295);
ELLRCEARLAECARGC (SEQ ID NO: 296);
QLRQCELRLQECGRHGN (SEQ ID NO: 297);
PLTSCEQKLAECARRF (SEQ ID NO: 298);
LLGMCELRLQECARAK (SEQ ID NO: 299);
ELSRCELKLEECARGM (SEQ ID NO: 300);
DCRPCESRLEECARRL (SEQ ID NO: 301);
RLSVCEARLEECARQL (SEQ ID NO: 302);
PLKMCEATVQECARLI (SEQ ID NO: 303);
LLLFCEARLSECARHV (SEQ ID NO: 304);
SLSMCEARLAECARLL (SEQ ID NO: 305);
PLFSCELKLQECARRCN (SEQ ID NO: 306);
SLERCYSRLEECGRRI (SEQ ID NO: 307);
PLTSCELRLRECALRSN (SEQ ID NO: 308);
KLAACELKLAECARRW (SEQ ID NO: 309);
KLAACELRLAECARRW (SEQ ID NO: 310);
ALTRCELRLAECARKI (SEQ ID NO: 311);
LLQQCELKLAECARSI (SEQ ID NO: 312);
QLWQCEARLLECARRS (SEQ ID NO: 313);
RLRLCESRLLECARSL (SEQ ID NO: 314);
QLETCVLKLEECARRCN (SEQ ID NO: 315);
ALSQCELRLAECARSVTK (SEQ ID NO: 316);
ELKLAECARRS (SEQ ID NO: 317);
ALSRCESKLAECARRQ (SEQ ID NO: 318);
LMSTCESKLRECARSL (SEQ ID NO: 319);
SLQRCEYKLGECARSL (SEQ ID NO: 320);
RLELLESRLQECARQLN (SEQ ID NO: 321);

QMEWCQARLAECARCCN (SEQ ID NO: 322);
PLFSCELKKQECARRCN (SEQ ID NO: 323);
LLDKCESRLSECARRL (SEQ ID NO: 324);
LLARCEARLEECGRQC (SEQ ID NO: 325);
DLLYCESRLAECGRM (SEQ ID NO: 326);
ALQMCEWRLEECARRL (SEQ ID NO: 327);
LLTMCEARLSECGRRL (SEQ ID NO: 328);
ALWRCESRLAECARRS (SEQ ID NO: 329);
LLATCAARLAECARQL (SEQ ID NO: 330);
LQTCEWKLAECARSN (SEQ ID NO: 331);
PLRSCESKLEECARQL (SEQ ID NO: 332);
CLRALDVKLAECARHL (SEQ ID NO: 333);
RLKTLELQLEECARRS (SEQ ID NO: 334);
KLRDVELKLAECARRS (SEQ ID NO: 335);
SLQRCEYKLASCARSL (SEQ ID NO: 336);
RLARCELRLAECARKS (SEQ ID NO: 337);
DLWYLESKLEECARRCN (SEQ ID NO: 338);
DLWYLESKLEECARRANG (SEQ ID NO: 339);
DLWYLESKLEECARRCNG (SEQ ID NO: 340);
KQRELELKLAECARRS (SEQ ID NO: 341);
QMQEWCARLAECARCCN (SEQ ID NO: 342); and
LLDICELKLQECARRAN (SEQ ID NO: 343).

111. The compound of claim 110, wherein the sequence is:
LLDICELKLQECARRAN (SEQ ID NO: 343).

112. The compound of claim 101, comprising a dimer having the structure of formula (VIII)

(VIII) 

wherein R^1 and R^2 are independently selected from the sequences of amino acids of formula (V); βA is a β-alanine residue; n1, n2, n3, n4, x and y are independently zero or one with the proviso that the sum of x and y is either one or two; and Lk is a terminal linking moiety selected from the group consisting of a disulfide bond, a carbonyl moiety, a C_{1-12} linking moiety optionally terminated with one or two -NH- linkages and optionally substituted at one or more available carbon atoms with a lower alkyl substituent, a lysine residue or a lysine amide.

113. The compound of claim 101, containing a disulfide bond.

114. The compound of claim 113, selected from the group consisting of:

[H]-DLWYLESKLEECARRANG-[NH_2] (SEQ ID NO: 339)
|
[H]-DLWYLESKLEECARRANG-[NH_2] (SEQ ID NO: 339);

[H]-DLWYLESKLEECARRCNG -[NH_2] (SEQ ID NO: 340); and
|____|

[H]-LLDICELKLQECARRAN-[OH] (SEQ ID NO: 343).
|_____|

115. The compound of claim 101, wherein the N-terminus of the peptide is coupled to a polyethylene glycol molecule.

116. The compound of claim 101, wherein the N-terminus of the peptide is acetylated.

117. The compound of claim 101, wherein the C-terminus of the peptide is amidated.

118. A pharmaceutical composition comprising a therapeutically effective amount of the compound of claim 101 in combination with a pharmaceutically acceptable carrier.

119. A method for treating a patient who would benefit from administration of a G-CSF modulator, comprising administering to the patient a therapeutically effective amount of a compound comprising a peptide chain approximately 9 to 40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids of formula (VI)

(VI) $X^V_1X^V_2X^V_3X^V_4X^V_5X^V_6CX^V_7X^V_8$ (SEQ ID NO: 6)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X^V_1 is E, C, Q, V, or Y; X^V_2 is E, A, L, M, S, W, or Q; X^V_3 is K, R or T; X^V_4 is L, A, or V; X^V_5 is R, A, M, H, E, V, L, G, D, Q, or S; X^V_6 is E or V; X^V_7 is A or G; X^V_8 is R, H, G or L.

120. The method of claim 119, wherein the G-CSF modulator is an agonist for the G-CSFR.

121. The method of claim 120, wherein the patient suffers from a depressed neutrophil count.

122. The method of claim 121, wherein the depressed neutrophil count is caused a condition selected from the group consisting of chemotherapy-induced neutropenia, AIDS-induced neutropenia and community-acquired pneumonia-induced neutropenia.

123. The method of claim 119, wherein the G-CSF modulator is an antagonist for the G-CSFR.

124. A compound comprising a peptide chain approximately 10 to 40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids of formula (VII)

(VII) $X^{VI}_1X^{VI}_2X^{VI}_3X^{VI}_4X^{VI}_5EX^{VI}_6X^{VI}_7X^{VI}_8X^{VI}_9$ (SEQ ID NO: 7)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X^{VI}_1 is A, E or G; X^{VI}_2 is E, H or D; X^{VI}_3 is R or G; X^{VI}_4 is K, Y, M, N, Q, R, D, I, S or E; X^{VI}_5 is A, S or P; X^{VI}_6 is E, D, T, Q, K or A: X^{VI}_7 is R, W, K, L, S, A or Q; X^{VI}_8 is R or E; and X^{VI}_9 is W, G, or R.

125. The compound of claim 124, wherein X^{VI}_1 is A.

126. The compound of claim 124, wherein X^{VI}_2 is E.

127. The compound of claim 124, wherein X^{VI}_3 is R.

128. The compound of claim 124, wherein X^{VI}_5 is A.

129. The compound of claim 124, wherein X^{VI}_6 is E.

130. The compound of claim 124, wherein X^{VI}_7 is R.

131. The compound of claim 124, wherein X^{VI}_8 is R.

132. The compound of claim 124, wherein and X^{VI}_9 is W.

133. The compound of claim 124, wherein the sequence of amino acids is selected from the group consisting of:

AERKAEERRW (SEQ ID NO: 344);
AERYAEEREG (SEQ ID NO: 345);
AERMAEERRW (SEQ ID NO: 346);
AERKAEERRR (SEQ ID NO: 347);
AHRNAEERRW (SEQ ID NO: 348);
AERKSEDWRW (SEQ ID NO: 349);
AERKAEEKRR (SEQ ID NO: 350);
AERQAETRRW (SEQ ID NO: 351);
AERNAEERRW (SEQ ID NO: 352);
AERQAEERRW (SEQ ID NO: 353);
AERRAEERRW (SEQ ID NO: 354);
AERDAEQRRW (SEQ ID NO: 355);
AERIAEERRW (SEQ ID NO: 356);
AERSAEERRW (SEQ ID NO: 357);
AERKAEELRW (SEQ ID NO: 358);
AERKAEESRW (SEQ ID NO: 359);
EERKAEERRW (SEQ ID NO: 360);
ADGKAEERRW (SEQ ID NO: 361);
ADGKAEELRW (SEQ ID NO: 362);
ADGMPEERRW (SEQ ID NO: 363);
ADGEAEKRRW (SEQ ID NO: 364);
ADGNAEERRW (SEQ ID NO: 365);

ADGEAEKARW (SEQ ID NO: 366);
AEGEAEKARW (SEQ ID NO: 367);
GERKAEERRW (SEQ ID NO: 368);
AEREAEERRW (SEQ ID NO: 369);
ADGEAEARRW (SEQ ID NO: 370);
ADGRAEEARW (SEQ ID NO: 371);
AEGRAEEARW (SEQ ID NO: 372);
AEREAEKARW (SEQ ID NO: 373);
AERKAEEQRW (SEQ ID NO: 374);
AERDAEKRRW (SEQ ID NO: 375); and
AEREAEKLRW (SEQ ID NO: 376).

134. The compound of claim 133, wherein the sequence of amino acids is selected from the group consisting of:

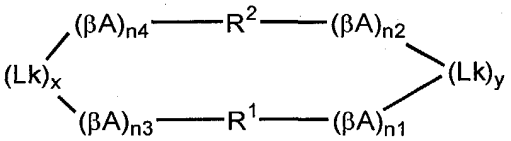
MLAERKAEERRWFNTHGRE (SEQ ID NO: 377);
MLAERKAEERRWFNTHGREK (SEQ ID NO: 378);
GGGMLAERKAEERRWFNTHGRE (SEQ ID NO: 379);
CMLAERKAEERRWFNTHGRE (SEQ ID NO: 380);
CMLAERKAEERRWFNTHGREK (SEQ ID NO: 381);
MLAERYAEEREGFNMQWRE (SEQ ID NO: 382);
MLAERMAEERRWFRRMG (SEQ ID NO: 383);
IVAERKAEERRRLNTEGHE (SEQ ID NO: 384);
ILAHRNAEERRWFQKHGR (SEQ ID NO: 385);
MLAERKSEDWRWLKTHGRD (SEQ ID NO: 386);
MLAERKAEEKRRLKTQGRE (SEQ ID NO: 387);
ILAERQAETRRWMRNAGSVTK (SEQ ID NO: 388);
MLAERNAEERRWLKRQCG (SEQ ID NO: 389);
MLAERQAEERRWLKMHGGE (SEQ ID NO: 390);

MLAERRAEERRWLKTQGGD (SEQ ID NO: 391);
MLAERQAEERRWLKTQGRD (SEQ ID NO: 392);
MLAERKAEERRWFKTHGRE (SEQ ID NO: 393);
MLAERKAEERRWFNNQGRE (SEQ ID NO: 394);
MPAERDAEQRRWLKTHGRE (SEQ ID NO: 395);
ILAERIAEERRWLKTQGR (SEQ ID NO: 396);
MLAERKAEERRWLQTHGRE (SEQ ID NO: 397);
ILAERSAEERRWLKTQGRE (SEQ ID NO: 398);
LLAERKAEELRWLKTHGRE (SEQ ID NO: 399);
MLAERKAEERRWLQTHGRE (SEQ ID NO: 400);
MLAERNAEERRW (SEQ ID NO: 401);
MFAERKAEESRWLQSQGRE (SEQ ID NO: 402);
MLEERKAEERRWLKTHGR (SEQ ID NO: 403);
MLAERKAEERRWLKMQGRE (SEQ ID NO: 404);
MLAERNAEERRWFYTHGRE (SEQ ID NO: 405);
MLADGKAEERRWLKTHGLD (SEQ ID NO: 406);
MIADGKAEERRWLKTHGRD (SEQ ID NO: 407);
MLADGKAEELRWLKTQGSD (SEQ ID NO: 408);
MLAERNAEERRWLKTHGRD (SEQ ID NO: 409);
MLADGKAEELRWLKTQGRE (SEQ ID NO: 410);
ILADGKAEERRWLKTHGRD (SEQ ID NO: 411);
MLADGMPEERRWLQTHGRD (SEQ ID NO: 412);
MLADGEAEKRRWLNTHGRD (SEQ ID NO: 413);
MLADGNAEERRWLMTHGRD (SEQ ID NO: 414);
MLADGEAEKARWLKTQGRE (SEQ ID NO: 415);
MLAEGEAEKARWLKTQGRE (SEQ ID NO: 416);
MLADGKAEERRWLKTQGRE (SEQ ID NO: 417);
MLAERKAEERRWLSAHVRE (SEQ ID NO: 418);

LLGERKAEERRWYKTHARE (SEQ ID NO: 419);
MLAERKAEERRWLMTHGHD (SEQ ID NO: 420);
MLAERKAEERRWLKSQCLE (SEQ ID NO: 421);
LLAEREAEERRWFKTHGRE (SEQ ID NO: 422);
MLADGEAEARRWFNMHGRE (SEQ ID NO: 423);
MLADGRAEEARWLKTQGSE (SEQ ID NO: 424);
MLAEGRAEEARWLKTQGSE (SEQ ID NO: 425);
MLAEREAEKARWLKTQGRE (SEQ ID NO: 426);
MMAERKAEEQRWFDIHGRD (SEQ ID NO: 427);
LTAERDAEKRRWLLTHGGE (SEQ ID NO: 428);
MLAERQAEERRWLKSQRGE (SEQ ID NO: 429);
LLAERKAEERRWFATHGRD (SEQ ID NO: 430);
MLAEREAEKLRWLKSQERA (SEQ ID NO: 431);
MLAERKAEERRWLKTHGGE (SEQ ID NO: 432);
KGGGMLAERKAEERRWFNTHGRE (SEQ ID NO: 490); and
KSTGGLTAERDAEKRRWLLTHGGE (SEQ ID NO: 491).

135. The compound of claim 124, comprising a dimer having the structure of formula (VIII)

(VIII)



wherein R^1 and R^2 are independently selected from the sequences of amino acids of formula (VI); βA is a β-alanine residue; n1, n2, n3, n4, x and y are independently zero or one with the proviso that the sum of x and y is either one or two; and Lk is a terminal linking moiety selected from the group consisting of a disulfide bond, a carbonyl moiety, a C_{1-12} linking moiety optionally terminated with one or two -NH- linkages and optionally

substituted at one or more available carbon atoms with a lower alkyl substituent, a lysine residue or a lysine amide.

136. The compound of claim 135, wherein the dimer is selected from the group consisting of:

MLAERKAEERRWFNTHGRE (SEQ ID NO: 377)
|
MLAERKAEERRWFNTHGRE-K(NH_2) (SEQ ID NO: 378) and

CMLAERKAEERRWFNTHGRE (SEQ ID NO: 380)
|
CMLAERKAEERRWFNTHGRE-K (SEQ ID NO: 381).

137. The compound of claim 124, containing a disulfide bond.

138. The compound of claim 124, wherein the N-terminus of the peptide is coupled to a polyethylene glycol molecule.

139. The compound of claim 124, wherein the N-terminus of the peptide is acetylated.

140. The compound of claim 124, wherein the C-terminus of the peptide is amidated.

141. A pharmaceutical composition comprising a therapeutically effective amount of the compound of claim 124 in combination with a pharmaceutically acceptable carrier.

142. A method for treating a patient who would benefit from administration of a G-CSF modulator, comprising administering to the patient a therapeutically effective

amount of a compound comprising a peptide chain approximately 10 to 40 amino acids in length that binds to G-CSFR and contains a sequence of amino acids of formula (VII)

(VII) $X^{VI}_1X^{VI}_2X^{VI}_3X^{VI}_4X^{VI}_5EX^{VI}_6X^{VI}_7X^{VI}_8X^{VI}_9$ (SEQ ID NO: 7)

wherein each amino acid is indicated by standard one-letter abbreviation, and wherein X^{VI}_1 is A, E or G; X^{VI}_2 is E, H or D; X^{VI}_3 is R or G; X^{VI}_4 is K, Y, M, N, Q, R, D, I, S or E; X^{VI}_5 is A, S or P; X^{VI}_6 is E, D, T, Q, K or A: X^{VI}_7 is R, W, K, L, S, A or Q; X^{VI}_8 is R or E; and X^{VI}_9 is W, G, or R.

143. The method of claim 142, wherein the G-CSF modulator is an agonist for the G-CSFR.

144. The method of claim 143, wherein the patient suffers from a depressed neutrophil count.

145. The method of claim 144, wherein the depressed neutrophil count is caused a condition selected from the group consisting of chemotherapy-induced neutropenia, AIDS-induced neutropenia and community-acquired pneumonia-induced neutropenia.

146. The method of claim 142, wherein the G-CSF modulator is an antagonist for the G-CSFR.

147. A compound comprising a peptide chain approximately 6 to 40 amino acids in length that binds to G-CSF and contains a sequence of amino acids selected from the group consisting of:

CTWTDLESVY (SEQ ID NO: 433);
HTTNEQFFMC (SEQ ID NO: 434);
DTWLELESRY (SEQ ID NO: 435);
HNSSPMVGVT (SEQ ID NO: 436);

DWQKTIPAYW (SEQ ID NO: 437);
RWGREGLVAALL (SEQ ID NO: 438);
WSGTRVWRCVVT (SEQ ID NO: 439);
MSLLSYLRS (SEQ ID NO: 440);
LDLLAI (SEQ ID NO: 441);
RIYGVK (SEQ ID NO: 442);
MIWHMFMSLLF (SEQ ID NO: 443);
FFWASWMHLLW (SEQ ID NO: 444);
FDDCWREREQFLFQAL (SEQ ID NO: 445);
CGRASECFRLLEM (SEQ ID NO: 446);
RECFQMLER (SEQ ID NO: 447);
CSIRWDFVPGYGLC (SEQ ID NO: 448);
WMQCWDSLSLCYDM (SEQ ID NO: 449);
ALLMCESKLAECARAR (SEQ ID NO: 450);
LAHCKKRKEECAAG (SEQ ID NO: 451);
SIDGVYLRTSRT (SEQ ID NO: 452);
SIDGVYLRTRSRTRY (SEQ ID NO: 453);
VWRLRGSTLRGLRD (SEQ ID NO: 454);
DRGGGTVGVYWWESY (SEQ ID NO: 455);
VWGTVGTWLEY (SEQ ID NO: 456);
LMWVSAY (SEQ ID NO: 457);
RASDEYGALVRFCTNL (SEQ ID NO: 458);
NYWCDSNWVCEIA (SEQ ID NO: 459);
LAHCLLRLEECAAG (SEQ ID NO: 460);
LALCLARLRECAGG (SEQ ID NO: 461);
CESRLVECSRM (SEQ ID NO: 462);
LLDIAELKLQECARRCN (SEQ ID NO: 463);
KLLDIAELKLQECCARRCN (SEQ ID NO: 464);

CSTGGGLTAERDAEKRRWLLTHGGE (SEQ ID NO: 465)
LTAERDAEKRRWLLTHGGEGG (SEQ ID NO: 466);
LTAERDAEKRRWLLTHGGEGGK (SEQ ID NO: 467);
LTAERDAEKRRWLLTHGGEGGGGG (SEQ ID NO: 468);
LTAERDAEKRRWLLTHGGEGGGGGK (SEQ ID NO: 469);
ESGWVW (SEQ ID NO: 470);
NSGWVW (SEQ ID NO: 471);
SGWVW (SEQ ID NO: 472);
PLGKCEATCREMARYFN (SEQ ID NO: 473);
SLQRCEYKLASVRGLCN (SEQ ID NO: 474)
DLWYLESKLEEAARRCNG (SEQ ID NO: 475);
PYMGTRSRAKLLRQQ (SEQ ID NO: 476):
RNAGERRWFKTQGWY (SEQ ID NO: 477):
MLAERNADDRRWFNTHGRD (SEQ ID NO: 478):
MMADGRLRNSVGLILWCD (SEQ ID NO: 479);
MLADGRLRNVVG (SEQ ID NO: 480);
LLADVRRRNGVGLLRMGRD (SEQ ID NO: 481);
MLADGRLRNFGG (SEQ ID NO: 482);
TYMTYVYWLC (SEQ ID NO: 483); (CORE 158)
RFGERWGL (SEQ ID NO: 484);
HWLWWGWNF (SEQ ID NO: 485);
RECFQMLERC (SEQ ID NO: 486);
ILAHRNAKERRWFQKHGR (SEQ ID NO: 487); and
CSTGGGLTAERDAEKRRWLLTHGGEK (SEQ ID NO: 489).

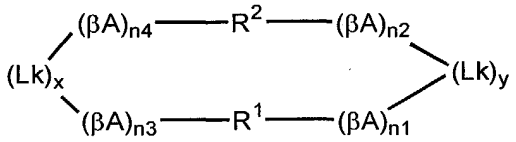
148. The compound of claim 147, wherein the sequence is selected from the group consisting of:

LLDIAELKLQECARRCN (SEQ ID NO: 463); and

KLLDIAELKLQECCARRCN (SEQ ID NO: 464).

149. The compound of claim 147, comprising a dimer having the structure of formula (VIII)

(VIII)



wherein R^1 and R^2 are independently selected from the sequences of amino acids of claim 122; βA is a β-alanine residue; n1, n2, n3, n4, x and y are independently zero or one with the proviso that the sum of x and y is either one or two; and Lk is a terminal linking moiety selected from the group consisting of a disulfide bond, a carbonyl moiety, a C_{1-12} linking moiety optionally terminated with one or two -NH- linkages and optionally substituted at one or more available carbon atoms with a lower alkyl substituent, a lysine residue or a lysine amide.

150. The compound of claim 149, wherein the dimer is selected from the group consisting of:

CSTGGGLTAERDAEKRRWLLTHGGE (SEQ ID NO: 465)
|
CSTGGGLTAERDAEKRRWLLTHGGE (SEQ ID NO: 489);

LTAERDAEKRRWLLTHGGEGG (SEQ ID NO: 466)
|
LTAERDAEKRRWLLTHGGEGG-K (SEQ ID NO: 467); and

LTAERDAEKRRWLLTHGGEGGGGG (SEQ ID NO: 468)
|
LTAERDAEKRRWLLTHGGEGGGGG-K (SEQ ID NO: 469).

151. The compound of claim 147, containing a disulfide bond.

152. The compound of claim 151, selected from the group consisting of:

[H]-DLWYLESKLEEAARRCNG -[NH_2] (SEQ ID NO: 475)

[H]-DLWYLESKLEEAARRCNG-[NH_2] (SEQ ID NO: 475);

[H]-LLDIAELKLQECARRCN-[OH] (SEQ ID NO: 463); and

[H]-KLLDIAELKLQECARRCN-[OH] (SEQ ID NO: 464).

153. The compound of claim 147, wherein the N-terminus of the peptide is coupled to a polyethylene glycol molecule.

154. The compound of claim 147, wherein the N-terminus of the peptide is acetylated.

155. The compound of claim 147, wherein the C-terminus of the peptide is amidated.

156. A pharmaceutical composition comprising a therapeutically effective amount of the compound of claim 147 in combination with a pharmaceutically acceptable carrier.

157. A method for treating a patient who would benefit from administration of a G-CSF modulator, comprising administering to the patient a therapeutically effective amount of a compound comprising a peptide chain approximately 6 to 40 amino acids in length that binds to G-CSF and contains a sequence of amino acids selected from the group consisting of:

CTWTDLESVY (SEQ ID NO: 433);

HTTNEQFFMC (SEQ ID NO: 434);

DTWLELESRY (SEQ ID NO: 435);
HNSSPMVGVT (SEQ ID NO: 436);
DWQKTIPAYW (SEQ ID NO: 437);
RWGREGLVAALL (SEQ ID NO: 438);
WSGTRVWRCVVT (SEQ ID NO: 439);
MSLLSYLRS (SEQ ID NO: 440);
LDLLAI (SEQ ID NO: 441);
RIYGVK (SEQ ID NO: 442);
MIWHMFMSLLF (SEQ ID NO: 443);
FFWASWMHLLW (SEQ ID NO: 444);
FDDCWREREQFLFQAL (SEQ ID NO: 445);
CGRASECFRLLEM (SEQ ID NO: 446);
RECFQMLER (SEQ ID NO: 447);
CSIRWDFVPGYGLC (SEQ ID NO: 448);
WMQCWDSLSLCYDM (SEQ ID NO: 449);
ALLMCESKLAECARAR (SEQ ID NO: 450);
LAHCKKRKEECAAG (SEQ ID NO: 451);
SIDGVYLRTSRT (SEQ ID NO: 452);
SIDGVYLRTRSRTRY (SEQ ID NO: 453);
VRWLRGSTLRGLRDR (SEQ ID NO: 454);
DRGGGTVGVYWWESY (SEQ ID NO: 455);
VWGTVGTWLEY (SEQ ID NO: 456);
LMWVSAY (SEQ ID NO: 457);
RASDEYGALVRFCTNL (SEQ ID NO: 458);
NYWCDSNWVCEIA (SEQ ID NO: 459);
LAHCLLRLEECAAG (SEQ ID NO: 460);
LALCLARLRECAGG (SEQ ID NO: 461);
CESRLVECSRM (SEQ ID NO: 462);

LLDIAELKLQECARRCN (SEQ ID NO: 463);
KLLDIAELKLQECCARRCN (SEQ ID NO: 464);
CSTGGGLTAERDAEKRRWLLTHGGE (SEQ ID NO: 465);
LTAERDAEKRRWLLTHGGEGG (SEQ ID NO: 466);
LTAERDAEKRRWLLTHGGEGGK (SEQ ID NO: 467);
LTAERDAEKRRWLLTHGGEGGGGG (SEQ ID NO: 468);
LTAERDAEKRRWLLTHGGEGGGGGK (SEQ ID NO: 469);
ESGWVW (SEQ ID NO: 470);
NSGWVW (SEQ ID NO: 471);
SGWVW (SEQ ID NO: 472);
PLGKCEATCREMARYFN (SEQ ID NO: 473);
SLQRCEYKLASVRGLCN (SEQ ID NO: 474);
DLWYLESKLEEAARRCNG (SEQ ID NO: 475);
PYMGTRSRAKLLRQQ (SEQ ID NO: 476);
RNAGERRWFKTQGWY (SEQ ID NO: 477);
MLAERNADDRRWFNTHGRD (SEQ ID NO: 478);
MMADGRLRNSVGLILWCD (SEQ ID NO: 479);
MLADGRLRNVVG (SEQ ID NO: 480);
LLADVRRRNGVGLLRMGRD (SEQ ID NO: 481);
MLADGRLRNFGG (SEQ ID NO: 482);
TYMTYVYWLC (SEQ ID NO: 483);
RFGERWGL (SEQ ID NO: 484);
HWLWWGWNF (SEQ ID NO: 485);
RECFQMLERC (SEQ ID NO: 486);
ILAHRNAKERRWFQKHGR (SEQ ID NO: 487); and
CSTGGGLTAERDAEKRRWLLTHGGEK (SEQ ID NO: 489).

158. The method of claim 157, wherein the G-CSF modulator is an agonist for the G-CSFR.

159. The method of claim 158, wherein the patient suffers from a depressed neutrophil count.

160. The method of claim 159, wherein the depressed neutrophil count is caused a condition selected from the group consisting of chemotherapy-induced neutropenia, AIDS-induced neutropenia and community-acquired pneumonia-induced neutropenia.

161. The method of claim 157, wherein the G-CSF modulator is an antagonist for the G-CSFR.